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ABSTRACT

Recent research has shown that computer technology, including databases, is becoming a part of social studies instruction. Yet it still is not clear how teachers are using databases and what are the outcomes from such use. The research reported in this document addresses three principal questions: (1) How do teachers use computer databases in teaching problem solving? (2) What do students learn during this kind of activity? and (3) What are the enablers and inhibitors of successful database use during teaching and problem solving? A case study approach was used in exploring the answers to these questions. Eight teachers and their students were observed during at least 10 class sessions; teachers and selected students were interviewed; and written teaching plans, class materials, and student projects were reviewed. Some of the inferences drawn from the study are that: time pressure affects teachers and students alike, but there are specific techniques for making good use of time when attempting computer based problem solving; lack of student knowledge must be anticipated by the teacher, who has to incorporate specific ways of overcoming the problem in teaching; and using small non-competitive groups of students works well. A 32-item list of references is included, as are 4 tables. (DB)

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Using Computer Databases in Student Problem Solving:
A Study of Eight Social Studies Teachers' Classes

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I. Purpose and Evolution of the Study

Introduction. The use of computer databases in social studies classrooms has been urged by many as an appropriate tool for facilitating higher-order thinking goals (Budin, Kendall, and Lengel, 1986; Collis, 1988, Ehman and Glenn, 1987; Hodges, 1985; Hunter, 1983, 1988). A recent national survey of experienced computer-using teachers found that indeed more social studies teachers are using computer databases than all other subject matter teachers. Fifty-two percent of the social studies teachers in the survey reported using databases (Sheingold and Hadley, 1990, p. 10). Apparently, more and more social studies teachers indicate that databases have become a part of their instructional plans.

While it is encouraging to find that technology and more sophisticated software are becoming part of social studies instruction, it is still not clear how teachers are using databases and the outcomes from such use. The research reported here addressed three principal descriptive questions:

1. How do teachers use computer databases in teaching problem solving?
2. What do students learn during this kind of activity?
3. What are the enablers and inhibitors of successful database use during the teaching and problem solving?

In order to explore the answers to these questions, a case study approach was used. During the spring of 1990, eight teachers and their students were observed during at least ten class sessions. In addition, teachers and selected students were interviewed and examined written teaching plans, class materials, and student projects were reviewed.

Evolution of the Study. The research was originally proposed in September, 1988 and was to involve a pilot study to clarify research questions followed by a structured field experiment. The experiment would focus on the impact of using databases on students' problem solving and information processing skills, and the impact on the overall instructional process. During the fall of 1989 two teachers in each site were selected for participation in the pilot study. Classrooms were observed during about one week of instruction. The data from these studies were the basis for the planning for stage two.

What became apparent from the pilot studies was that we did not yet have a clear picture of how databases were being used in the social studies classroom. We were not ready to develop an experimental design. Therefore, during the summer of 1989 we decided on a series of case studies in which the teachers would be free to implement a problem solving model as they wished as long as it incorporated a computer database. The studies would focus on the variation among teachers and their students to demonstrate a broad range of databases and the outcomes in the problem solving context. This decision would permit the teachers to act and teach as they normally would. By observing these actions, we wanted to create an authentic picture of what happens in the classrooms of experienced computer-using social studies teachers and describe the issues, problems, and opportunities encountered while using computer databases as part of a problem solving instructional unit.

The case study approach is an appropriate research tool when investigating a phenomenon within its real-life context; when the boundaries betwee phenomenon and context are not clearly evident; and in which multiple sources of evidence are used (Yin, 1989). Our situation seemed to incorporate all three of these criteria.

This study is not qualitative, even though some techniques used--openended interviews, observations, and case studies--are often used by qualitative researchers. Nor is it a "meta-ethnography," or interpretive synthesis of case study material, described by Noblit and Hare (1988). At best the research is an attempt to synthesize and aggregate by identifying what is common in most or all of the case study classrooms.

By focusing on the common we ignore much of what is unique to any one of the settings. The use of multiple case studies allowed us to generalize to theoretical propositions but not to populations or universes (Yin, 1989).

II. Previous Study About Use of Databases in Social Studies

There is more speculation about the efficacy of using databases in social studies classrooms than systematic research on the extent, processes, or outcomes of such activity. Nevertheless, a few relevant

studies based on classroom work have been reported. The studies may be divided into two broad areas -- the extent of use in social studies classrooms and field studies using databases. Both are briefly discussed here in order to provide a context for our case studies.

Extent of Use. During the last five years there appears to be a very small, but growing, use of databases by social studies teachers and students. Hunter (1988) reported an increasing number of social studies databases available commercially, and being developed and used in schools (pp. 82-83; 85-86). Sheingold & Hadley also found that 52% of the social studies teachers in their survey (N=608/1,200) were using computer databases in their classroom work--the largest percentage of all subject matter teachers in the study (Sheingold & Hadley, 1990, p. 10). Although the research was limited to very selected and experienced computer-using teachers, it suggests that databases are viewed as important computer tools in the social studies. Hunter's and Sheingold & Hadley's research reveal the changes that have occurred since the mid-1980's.

For example, Becker's 1985 survey (N=2,101 schools) showed that in grade ranges K-3 and 9-12 only 1% of teachers used computers in teaching social studies, and only 4% of the teachers in grades 4-8 used them (Becker, 1986, Issue 3, p. 8). Becker did not ask specifically about the use of databases, however. A study of the National Assessment of Educational Progress (N=approximately 2,000) tested student knowledge of databases and found that students "...do not have a good understanding of the structures or functions of databases" (Martinez & Mead, 1988, p. 14).

Three surveys of social studies teachers reveal more detail. In a national survey of secondary social studies teachers (N=262/500) in 1987-88, Ross (1988) reported that 29% used computers during the school year. Of the total computer applications used by them, 8% were databases. White (1988) found the same level, 29%, using computers in his 1988 survey of N.C.S.S members (N=609/1,200), but did not report about database use. Northup & Rooze (1990) also surveyed N.C.S.S. members in 1987-88 (N=405/800), and showed that 55% of teachers who reported access to computers (or 46% of the total teachers responding) used them. Of the computer users, 33% reported using databases at least once, and 11% said that databases were their main use. Higher percentages reported using simulations (24%,)

word processing (29%,) and drill/practice programs (18%). Of the total number of teachers 15% (61/405) used databases in some way during the period covered by the survey.

While the percentage of social studies teachers using computer databases remains small it appears that more and more experienced computer users are beginning to use databases as part of their instructional units. One might speculate that as better software and more equipment become available, use will continue to increase.

Field Studies Using Databases. Field studies may be divided into three general categories--cognitive outcomes, affective outcomes, and process/intervening factors. Studies may also be divided into those whose claims are made on the basis of scientific studies (field studies) from those based on impressionistic reporting. The latter are not devalued, because they often contain important descriptions of and insights into particulars lacking in the scientific studies. But the impressionistic claims are not to be confused with claims based on qualititative research, which is systematic and interpretive. There are no studies in the literature on the present topic that we believe are qualitative in that sense. Studies included here as impressionistic appear to be just that--descriptive reports of classroom use of databases with no attempt to observe, interpret, and report systematically within any of the qualitative frameworks.

Classroom Studies--Cognitive Outcomes. Some of the important features of the six field experiments are summarized in Table 1. Unfortunately, information for some of the categories is either very sketchy or not available in the research reports, and therefore marked as "NA" (not available).

The most tightly controlled field experiment was conducted by White (1986, 1987). He compared classes using computer databases with those working on the same data without computers. The outcome studied was information processing skill, which included three factors: 1) judging relevance; 2) judging sufficiency of information for solving particular problems, and 3) discriminating between efficient and inefficient organizations of information for solving problems. When White controlled for verbal ability and attitude toward using computers, the computer-using classes outperformed the non-computer classes; the effect size was +.27.

Another classroom study was reported by Elder (1988). She found no significant differences among two computer-using and one noncomputer-using group of classes on a test of geographic knowledge. She also used White's information processing skill measure, and found no significant difference (effect size = +.10) on that outcome, either.

Problem solving effectiveness was the focus of a study by Rawitsch (1987, 1988) He compared computer and noncomputer classes using databases, and found that the computer classes solved more problems (effect size = +.33), and they took more time to solve these problems that the non-computer using students (effect size = -.35). A third result was that there was no difference in efficiency ratios (effect size = -.03), where efficiency was defined as the ratio of time required to solve eight problems to the number of correctly solved problems.

A field experiment pitting classes using computer databases with those not using computers on the same legal data found no statistically significant differences on a test of understanding the 26th amendment (18 year old vote,) the topic taught in the experimental unit (Cornelius, 1986). The average effect size of the computer versus noncomputer groups across both posttest and delayed posttests was +.68. Also, like Rawitsch (1987, 1988) Cornelius reported that computer-using students took more time for their work than those not using comptuers. The treatment consisted of only one day of instruction with only 36 students, and therefore the validity of these findings appears to be extremely low.

The final study comparing computer and noncomputer classes (Underwood, 1985) found no differences on factual recall after using student-created classification databases. But there were differences favoring the computer students on the classification skills of observation, discrimination, and pattern recognition, and in the frequency of asking of "constraint-seeking" questions rather than "specifics-seeking" questions.

One study compared use of one kind of computer task with another. Rawitsch, Bart, and Earle (1988) compared classes using computer simulations with those using computer databases on the higher order thinking skills of proportional reasoning and hypothetical-deductive reasoning, and found no differences on either skill.

In summary, five of the six field studies (all except Rawitsch, Bart, and Earle) compared classes of students using computer databases with those working on the same data without computers. None of the studies found differences in achievement of facual information. White and Underwood found differences in information skills which favored computer databases. but White's findings were not replicated by Elder. Rawitsch found a difference in numbers of problems solved which favored computer classes, but also found that more time for problem solving was required by these students.

Researchers conducting informal descriptive studies reported several interesting claims about cognitive outcomes in their classrooms which bear on the present study (see Table 2 for feature descriptions of these studies). Elder (1988), referred to above, commented that students quickly learn how to manipulate computer database information, but have difficulty in determining relevance and sufficiency of the information when actually applying it to form generalizations and other problem solving activities (p. 117).

In an early study Rothman (1982) had students create their own databases of information about political revolution. He reported that as a result of the activity students were able to visualize complex historical relationships, develop a critical awareness of current and historical events, and integrate information from various library sources of information. In another early study (Traberman, 1983, 1984) the APL programming language was used by eighth graders who created their own databases, as well as analysis and presentation programs. Traberman asserted that student learned facts as well as concepts, and showed deeper understanding of the concepts and generalizations because they actually manipulated the raw data and developed the presentations.

Mendrinos and Morrison (1986) and Morrison and Walters (1986a, 1986b) described the use of a database whose subject was Irish immigration to the U.S. They found that students developed awareness of the personal reality of that historical process. Teachers also believed that quality of writing improved as a result of student involvement with the computer database and other materials.

Classroom Studies--Affective Outcomes. Only two of the field studies used scientific measures of student attitude outcomes. Both Cornelius (1986) and Rawitsch (1987, 1988) found more positive

attitudes toward use of computer databases in problem solving among students in computer-using classes, although in the Cornelius study there was a difference in only one of two comparisons (average effect size of +1.08).

Impressionistic claims about affective outcomes are made in four reports. Rothman (1982) suggested that general motivation of students was improved, and that involvement was increased, even in heterogenously grouped classes, where lower ability level students were stimulated by manipulating the computer and by the visual aspects of the work. He also reported that classroom discussions were stimulated. In their work with the Irish immigrant database, Mendrinos & Morrison (1986) observed that the learning was more fun, interesting, and challenging, and student involvement was higher. Ennals (1985) also claimed higher student motivation in learning with the use of computer databases. Similarly, Traberman (1983, 1984) observed increased motivation and excitement among students using the APL language in programming their own databases. She also reported that students became more active learners during this experience.

Classroom Studies--Teaching and Learning Process Factors. Rawitsch (1987, 1988) hypothesized that student work style would be related to problem solving efficiency among students using computer databases. He did find that the more structured work style students were more efficient than those with more unstructured styles.

Other interesting and important observations about a variety of classroom process factors relevant to the present study are made in several of the impressionistic reports. For example, groups of students. not individuals, usually work with computer databases. Over all of the studies, the typical group size appears to range from two to four students. Rothman (1982) found salutary effects of group work on cooperation and organization skills. Although they studied use of lower level computer assisted instruction in social studies, not database use, Johnson, Johnson, and Stanne (1985) found that cooperative group work with computers enhanced factual recall, application of factual knowledge, and problem solving skill when compared to competitive group or individual group work on the same material. Use of cooperative groups was a notable feature in the eight cases of the present study.

Hawkins and Sheingold (1986) reported that in their two-month study of a 6th grade social studies class, there was lack of integration of the database software into the curriculum, and that the structure of the software, one in which recording of information over multiple cases was necessary, was a primary cause. They concluded that in their case study the database software did not support problem solving and critical inquiry.

The size of the database might be an important criterion in deciding whether to have students use a computer in manipulating the information. Ennals (1985) speculated that small sets of information might better be presented and used by stduents in print form, whereas large datasets would be better worked on with computers.

Finally, Elder (1988) makes the important observation that teachers need considerable training and practice in direct and indirect teaching methods, in classroom management, and in working with student groups, if computer database units are to be successful. She spent 4 1/2 days training the teachers in her study, and asserted that this was insufficient.

Summary of Claims. The research studies directly related to databases are few in number and the evidence for the claims is often quite thin. It is possible, however, to highlight several points that directly relate to the case studies reported here and the three major descriptive questions posed at the outset of the study.

> How do teachers use computer databases in teaching problem solving? Teachers appear to use databases to develop higher order thinking or problem solving skills. No study claimed a relationship between database use and lower level knowledge acquisition or recall.

> What do students learn during this kind of activity? There is some evidence that there is a positive impact of instruction using databases on higher order thinking skills.

What are the enablers and inhibitors of successful database use during the teaching and problem solving? There is some evidence to suggest that students like to use computers in manipulating information. Also, their attitudes toward computer assisted problem solving become more positive as a result of their use. Cooperative student groups of two to four are effective in organizing instruction for computer use.

III. Description of Teachers, Students, Schools, and Units Taught

We have summarized in Table 3 some of the key characteristics of the schools, the teachers and students we observed, and the problem solving units that were taught. Some common features are noteworthy. All of the teachers were relatively experienced computer users, and each had a computer and printer in their classroom except for the Washington 5th grade teacher. The students were also generally experienced, in the use of computers in the classroom. Computer laboratories were available to the teachers in all of the schools.

All of the teachers were willing to have the researchers in their classrooms, and had their administrators' support for involvement as well. More important, all of the teachers were willing to construct and teach a "problem solving" unit of 10 or more days, with use of a computer database as an integrated part. All used small student groups in noncompetitive problem solving teams, rather than having students work individually, or having the class working as a whole. Further, each teacher agreed to have the student teams produce an oral report for the whole class, and most required a written version of the report as well.

There were many important differences among the eight teachers and their classrooms. Teaching experience ranged widely, although all teachers had at least six years of experience. Their experience with computer databases ranged from very little to extensive. Students varied in grade and ability level. There were no urban schools, but there were rural and suburban, as well as large and small, schools. Class sizes ranged from 15 to 34. The courses taught spanned nearly all social studies subjects. There was a corresponding range of unit topics.

Six of the eight teachers used Apple IIe computers with an AppleWorks-based database. In Washington, the two teachers and their students used Apple IIGS computers with the MECC USA and/or World GeoGraph databases.

The most fundamental difference among the eight teachers had to do with their interpretation of "problem" and "problem solving," and how they incorporated their meanings of these concepts into the units they planned and taught. In the section below, in which the individual units are described, we indicate some of the differences among units.

Teachers differed in the nature of the problems to be addressed by students in the study. For instance, Minnesota teacher #2 focused on contemporary social problems needing remedy. Indiana Teacher #2 used a variation of the hypothetical-deductive method, examining economic and social historical trends over 40 years. Others' problems were descriptive--collecting and displaying geographic information about Western U. S. states "solved" the problem for Washington teacher #1's students. Indiana teacher #1's problem had to do with defining meaning empirically for the categories of "developed," "less developed," and "underdeveloped" countries.

We realize that this broad array of meanings of "problem" and "problem solving" does not fit within any scholarly conception of those ideas held by social studies educators. Nevertheless, they are valid meanings in one sense--they were held by the teachers in our case studies, who used them in planning and teaching their units Whether we or others agree with their interpretations, they are important reflections of beliefs about and ways of carrying out social studies teaching. We suspect that equally wide differences among other social studies teachers would be found through observations and interviews like ours.

There was also a notable difference in the openness of problem selection which teachers permitted their students. Indiana teacher #1, Virginia teacher #2, and Minnesota teacher #1 were entirely closed--they chose the "problem" to be worked on, rather than allowing students any choice. On the other extreme were Indiana teacher #2 and Minnesota teacher #2, who encouraged students to address any problem they chose to define within the scope of the database used.

These observations about important differences among the cases leads to thumbnail descriptions of the teaching units in each of the case studies, and then the methods used to carry out the study.

Descriptions of Individual Classroom Units.

Indiana #1. The 12th grade economics unit centered around definitions of developed, developing, and less developed countries presented in the "World Economy" unit of the 12th grade text. The unit fit well with the progress of the course to that point. The "problem" to be solved was chosen and presented by the teacher as "How do we know what country is developed and which ones are less developed?" Students used MECC's World Communities database, together with almanacs and other library reference materials, to retrieve and organize data into tables so that criteria for classifying the countries could be applied and refined. Groups of two students were assigned between 8 and 10 countries to research and classify. Oral and written reports were presented at the end of the unit.

Indiana #2. The 10th/11th grade U. S. History teacher integrated information about the U.S. Census with a researcher-provided county and state database extracted from Census Bureau City and County Data Books from 1940 through 1985. Students in teams of 2 and 3 developed "problems," and then specific hypotheses, from working with the 30 database categories--social and economic variables recorded over a 40-year period. For example, one group speculated that the percentage of low income families was related to divorce rates over time, another group worked on the idea that the rapid decline of numbers of farms from 1940 to 1980 was due to application of technology. Students used data from the database, library reference works, and interviews to test their hypotheses. Each team gave an oral and written report at the end of the unit.

Minnesota #1. This 9th grade American civics unit involved students in groups of 2 to 3 in using information from researcher-created databases to solve one of the following foreign or domestic policy "problems" which was assigned to them:

How does a nation's wealth and population affect the living conditions of its citizens? What factors besides who gets involved in politics determine a nation's political climate? What are some of the effects of the continued growth of our country's population? How healthy is the

country's economy? What are some of the factors that give rise to crime? What problems can result from the poverty in our country?

The students assumed roles of consultants to the U.S. Congress, and wrote a description of their problem, and then extracted relevant information in the form of "connections" to the problem. Oral presentations together with visual data displays completed the unit.

Minnesota #2. This four-week unit involved a researcher-created economic database on Minnesota counties. Teams of 4 students identified and proposed a solution to a "problem" relating to Minnesota's economic future, and then were assigned a "political perspective" by the teacher. After this phase, teams presented drafts of written proposals three times to a commission of students representing each team, which critiqued the proposals. Revisions were made after each critique. The best of the proposals, judged during the third critique, were presented orally to a bi-partisan commission of Minnesota state legislators at the state capitol.

Virginia #1. This U.S. Government unit used the Newsworks American Government database. The general focus was the interrelationship of executive and legislative branches of the U.S. government, as evidenced by study of 19th and 20th century national election data. Students working in groups of 3 hypothesized about elections and electoral politics over time and then applied data in testing the hypotheses. Oral reports were made by the student groups.

Virginia #2. Students worked in teams of 3 in applying information and ideas from their previous study of the French Revolution to current problem areas of the world. They used the Newsworks World Community database in extracting economic, social, and political data which suggested in which countries revolution might occur in the future. The student groups presented oral reports which consisted of role playing a citizen of the country they had chosen who argued during a brief simulated radio or televsion spot why there should or should not be a revolution in their country.

Washington #1. This fifth grade teacher selected USA GeoGraph as the information resource for student written reports on specific states in the U.S. Students worked in teams of 2-3 to find and integrate information from the computer database and other print materials. They used word processing

and Printshop programs on the computer to produce their written reports; some made oral reports as well

Washington #2. Sixth grade students working in groups of 4 studied the geography of the western U.S. and economy of Europe by using both USA GeoGraph and World GeoGraph computer databases, plus print and nonprint sources. They focused on similarities and differences between states in the U.S., and countries in Europe. With the required written (and some oral) reports on Europe, students had the problem of describing the economy of a "perfect" country, and justifying these scenarios.

IV. Methods Used in the Case Studies

We used differing methods to study the classrooms of the eight teachers. Decisions about what methods to use depended upon local circumstances ranging from constraints from use of human subjects committees, to teacher preferences, to distance from the school, to researchers' available time and assistance. Table 4 contains some key features of the methods used.

There were some constants across the sites. All of the units were taught during the second half of the second sememster. Except for the Washington sites, the teachers had been involved in the previous fall semester's pilot studies. In all sites teachers were interviewed prior to and after the end of the units, and periodic post-lesson debriefings with the teachers were also conducted after many (but not all) of the daily class observations. Researchers wrote field notes corresponding to their observations in each class session; these notes integrated interviews and discussions with teachers and students.

Important differences include the means of obtaining information from students. Questionnaires to tap student perceptions about the units were used in the Washington sites, while questionnaires used in the Minnesota sites aimed at prior student computer experience. No student questionnaires were used in Indiana or Virginia. Post-unit student interviews were conducted in the Minnesota sites with some teams. In Indiana, the teachers debriefed their classes as whole groups for perceptions about the units, using questions devised by the researcher. No end of unit interviews or debriefings with students were

conducted in the Virginia or Washington sites. The Minnesota researchers videotaped some student groups in one teacher's classroom, and the whole class in the other's. In Virginia, the oral reports were videotaped. Analysis of student questions and problems in Minnesota were made from some of these videotape records.

V. Observations and Interpretation of Classroom Problem Solving

In this section we draw together the observations, interviews, debriefings, teacher plans and materials, student reports, and other material comprising our work with the eight teachers and their students. We begin with the problem solving model that we asked each of the teachers to use in planning their unit. After discussing three "overlay factors" which influenced all of the individual parts of the problem solving model, we discuss data from the classroom case studies with respect to related groups of problem solving components.

The model we specified for teachers was adapted by the researchers for use in the computer database context, and includes these parts:

A. Teacher introduces the unit and its objectives
B. Teacher introduces (as much as needed) the concept of databases
C. Teacher introduces (as much as needed) the operation of the database tool to be used
D. Students practice with the database tool
E. Teacher introduces the problem area
F. Students scan the database to get a feel for the problem
G. Students focus or define the specific problem they will work on
H. Students formulate a question or hypothesis about the problem's solution
I. Students determine which information they need to solve the problem
J. Students use the database to find the information
K. Students organize and manipulate the data as they work on their solution
L. Students test their information against their question or hypothesis and draw a tentative conclusion
M. Students test their conclusion against another situation and integrate their information in drawing a confident conclusion
N. Students report on the results of their problem solving; teacher evaluates the reports on the following criteria:
    - clarity of problem description
    - workability of hypothesis or question
    - quality of data used:
        - relavance
        - sufficiency
        - fairness of use

quality of organization and display

reasonableness of conclusion

O. Teacher leads a debriefing of the activity

As pointed out in the descriptions in Section IV, the teachers implemented the model in different ways, beginning with the meaning they placed on "problems," and the degree of choice permitted students in picking one or more "problems" to address. They emphasized some parts of this model more than others. We do not assert that each teacher put the model into practice in the same way, as would be the assumption in a field experiment, where the fidelity and consistency of the "treatment" variable would be of upmost importance. In our confederation of case studies, we made the conscious decision to let this "model implementation" vary from teacher to teacher, depending upon how the teachers themselves choose to interpret and use it in the classroom. The variations across cases are, perhaps, the most important features of the study.

<u>"Overlay Factors"</u>. There are three themes running through our case studies that transcend so many different categories of the problem solving model that we view them as "overlay factors" impinging on the whole process. These are small group work, prior student knowledge, and time.

All eight teachers had students work in groups of from 2 to 4 students. Teachers and students alike endorsed this as a positive feature of their problem solving units. We observed, and the participants commented on, many instances of cooperative, non-competitive work in the groups. There was much peer tutoring, both within and across groups. Students helped one another with computers, vocabulary, organization of tasks, and they collaborated actively in generating possible problems, hypotheses, and strategies for integrating information into testing ideas and creating the reports. There was a healthy amount of challenging one anothers' ideas within group members. Furthermore, groups generally stayed on task, both in their computer work and in other stages of the unit.

Of course, not all groups worked smoothly, and there was frustration expressed by a few students about some group members taking "free rides" on the work of others, and some hardships caused by absences of students upon whom others were depending for data, loaned books, and so forth. In a very few cases, one student "hogged" the computer, or otherwise intimidated others in the group.

However, these problems and concerns were slight compared to the teachers' and students' enthusiastic endorsement of small group work in this kind of learning context.

The small groups factor was very positive. In contrast, many students lacked sufficient knowledge about subjects they were investigating, and this general problem detracted from the units' objectives and student success as problem solvers. For example, the 5th graders in the Washington site had little knowledge of geography of the U. S., and this caused the teacher to have to spend more time than anticipated teaching vocabulary, basic geographic concepts, and facts, before carrying on with using the computer. In the 12th grade government classes in Virginia, lack of student knowledge about U. S. history and government inhibited their effective use of the elections database. Similar problems were observed and reported in Minnesota and Indiana classes. This condition plagued all of the teachers to some extent. Students' inability to work in a knowledge vacuum is underscored by our study.

The third overarching theme running through all of the case studies was that of time. There was the time pressure, felt by teachers and students alike, to finish the activity, or lesson, or unit, in order to get on to the next one. Adding use of computers adds to this pressure; to do a good job extra preparation, instruction, and practice with such mechanics as database commands and printing sequences were necessary.

We often heard the complaint from students, and a few of the teachers, that they needed more time--for students to collect more evidence or to write reports; for teachers to do more debriefing or computer lab work. In short, a unit on problem solving with computer databases tends to increase the push of time in the classroom.

There is another side of this issue. We sometimes observed a definite waste of time, sometimes by students, and sometimes by teachers. Teachers sometimes backtracked unnecessarily because of ineffective planning, organization, or teaching in the classrooms. Students were sometimes off task for extended periods of time, and sometimes their teachers knowingly permitted that to continue. Closer monitoring and "withitness" could have increased the on task time, and therefore the total available time in the unit. Moving students from the regular classroom to the computer lab (or library) and then back,

all in one class period, takes significant extra time; having students meet at the beginning of the period in the computer lab would save time, and only requires a bit of foresight.

Observations About Specific Model Components. We now turn to our perceptions about how specific parts of the model were implemented, and what the facilitators and inhibitors were of successful problem solving by the student teams.

A. Teacher introduces the unit and its objectives.
B. Teacher introduces (as much as needed) the concept of databases
C. Teacher introduces (as much as needed) the operation of the database tool to be used
D. Students practice with the database tool

These first parts of the problem solving model constitute an "introduction." Not surprisingly, the eight teachers chose quite different sequences, implemented each part in a unique way, and differed considerably in the emphasis put on the four parts. Four of the teachers began on the first day of their units by launching straight into the concept of and operation of databases; the other four began with an overview of the unit, expectations for assignments, and in two cases, the problem solving model. The introductory phase took from one to four days to complete.

Virginia Teacher #2 was one who emphasized the database operations right from the beginning. She lectured about databases in general, and then the NewsWorks world countries database to be used in the unit. She used an LCD display and her teacher computer to show various commands and resulting screens. Then students practiced retrieving data, using a worksheet involving two example countries, and handed in the worksheet at the end of class. The teacher used those completed worksheets as the basis for correcting misperceptions and mistakes during the subsequent class period, before going on to more database operations and worksheets for the unit.

In contrast, Indiana Teacher #2 spent three days introducing his unit before beginning to use computers. He used parts of lessons from the U. S. Census Bureau to spark interest in the census, then being taken in his county; local and state data from previous census years was what the students eventually used in the unit. The teacher had the students study and interpret small sets of local and state population trend data given to them on paper, this was his way of providing students a bridge to

the use of databases, where they retrieved and organized more complex datasets. The teacher also spent considerable time during the introductory phase on presenting and clarifying the unit goals and assignments, although he did not emphasize the problem solving model. His students had used the model before in his class, and he apparently felt that repetition was unnecessary.

These are abstractions of what actually happened during the unit introduction phase in these two classrooms, of course. But they illustrate the range of approaches taken by the eight teachers. Other examples of variations abound in the case studies. Two of the teachers simply ignored the problem solving model altogether; it was never mentioned during the unit. Other teachers emphasized it at several points during their units. Two of the teachers depended heavily upon the researchers for support on using the the databases, with Virginia #1 calling on the researcher to make a presentation to the class when the topic was being introduced.

It was clear from the case studies that at the end of the introduction phase of the units, students differed greatly in their grasp of the "big picture"--unit goals, specific assignments (all classrooms had oral reports of some kind, and several had written reports as well,) sequence of activities, and the nature of the problem solving steps expected by the teacher. Students in some classrooms were relatively well prepared at this point to go on with the rest of the unit, and some were completely in the dark.

Also clear was that the strength of the units' introductions--the clarity of goals, whether the overall topic was introduced in an interesting way, the clarity of expectations for students--were very important in shaping the eventual problem solving success of the students. These factors seem much more important than the nature and operation of databases, but some of these teachers began with and emphasized databases in a way that deflected students away from the essential nature of what they were expected to do--engage in complex, higher order, thinking. Two field notes excerpts from day 6 of a 10 day unit clearly illustrates this whole issue:

> ...[the teacher] presented to the students a transparency of the problem solving model [prepared by the researcher]. She basically read the steps and then asked the students to brainstorm possible hypotheses they could use. Students were surprised that this was the heart of the project....

> [After having first seen Worksheet #3, setting out the requirement of the final presentation]

[s]tudents appeared to understand the task before them, although they expressed some frustration that the "main question" had not been presented earlier (in lieu of some of the [computer] worksheet material).

Another main point from the unit introductions is that teachers generally did not have students practice database operations sufficiently before throwing them into work on problem and hypothesis development. Virginia Teacher #2 described above was an exception--her rather carefully planned introduction to database use, with practice worksheets that she checked and used to create subsequent instruction is a good model. Unfortunately, several of the other teachers assumed too much about students' database understandings and skills. Comments were made repeatedly in the field notes about specific database problems, encountered by students as they attempted to study their problems, that might have been avoided by more systematic practice during the first part of the units. As a result, considerable time was spent reviewing commands and correcting simple mistakes. It might have been that part of this seeming lack of attention by teachers to providing for early student practice had to do with teachers' lack of database knowledge and skills, and unwillingness to operate outside their "technology comfort zone."

Related to this point is lack of emphasis during the introduction on the meanings of the database categories. If this is ignored, students tended to use the simple labels in the database as the only source of what the categories meant. In many cases the label is not sufficient or even misleading. Although one teacher-- Indiana #1--used the category definitions of the "World Communities" database as an early part of his introduction, with questions and answers about the various categories, even his class had continuing problems in figuring out what categories meant. Unfortunately, they were typical of students throughout the cases in that they resisted using the materials provided them to learn the category meanings; they would ask each other, the teacher, or even the researcher, but used the printed information only as a last resort, often refusing to consult it at all. This issue of category definitions needs to be made as important a part of the unit introduction as database commands.

E. Teacher introduces the problem area
F. Students scan the database to get a feel for the problem
G. Students focus or define the specific problem they will work on
H. Students formulate a question or hypothesis about the problem's solution

This phase of the problem solving model revealed a rich set of examples of student thinking and teacher guidance--both positive and negative. Some students were confused and overwhelmed at times; this often resulted from too little or unclear structure and expectations provided by the teacher. Other students were unsure of what variables in their database might be related to the problem area they chose. We speculate that another part of this problem was the lack of "mental process models" to guide the students. Few teachers actually used example data to generate problems, questions, and hypotheses as a model process for what they expected of students.

Excerpts from field notes on one of the teachers are revealing:

> Some [students] carried through problem solving, others didn't. The key stumbling block [for those that didn't] was clear formulation of the question. Without that step their work lacked focus and logic--they mostly grubbed around with unconnected bits of data.

> Students had relatively little structure about what social trends and hypotheses to investigate, but were given a clear process to follow in choosing them, including modeling by the teacher in the three lessons used to begin the unit. [The teacher] insisted that students develop three or more problems/hypotheses before choosing one to work on, and worked with groups on that. He also checked the groups' written outlines daily.

The first excerpt underscores the fundamental idea that without a clear problem, or question, working with data will be aimless, and thinking outcomes will not be achieved. This is exactly what we saw in our cases. There is nothing surprising here, but the point needs to be reiterated. Teachers cannot afford to gravitate towards the mechanics or glitter of the database at the expense of ensuring the central preconditions for effective problem solving.

The second excerpt presents one way that an effective teacher pressed students to spend sufficient time and thought on identifying and clarifying their questions and hypotheses. We noticed that he had the groups develop not one but three hypotheses, this helped avoid premature closure on the first idea that popped into their heads. (This was a problem observed in some other classrooms in our study). He also monitored student progress throughout this phase, including specific feedback to the groups on their written outlines of their topic. This process seemed very important in keeping students on track, making suggestions to them about alternatives, and reemphasizing the various parts of the problem solving model.

In contrast, another teacher had students complete four worksheets during this period, given to them one at a time, in which they assembled social, political, economic, and cultural information from the database. The problem was that the students were not told that they were expected to connect and interpret this information around problems and questions later in a final report. Obviously, the students would have benefitted more had they been given the overall framework and assignment at the beginning.

A concluding observation relates to the interactive nature of students' problem formulation. Problems were often pieced together after much "messing around" with the data. For those students who began with a more or less clear question or problem, examining and manipulating data often led to changes or even disgarding what they started with. The process we observed was definitely not linear, nor did we want or expect it to be.

I. Students determine which information they need to solve the problem
J. Students use the database to find the information
K. Students organize and manipulate the data as they work on their solution
L. Students test their information against their question or hypothesis and draw a tentative conclusion
M. Students test their conclusion against another situation and integrate their information in drawing a confident conclusion

Once a problem is defined, and questions or hypotheses formed, the students have to work back and forth between the database and their questions, manipulating, adding to, and throwing out data, and modifying the questions. Field notes from this phase reflect the rough and tumble, nonlinear, nature of problem solving. The notes also reveal that students had many problems with the parts in this section, and these difficulties help us understand enablers and facilitators of the process.

There was relatively little student planning about what data were needed to engage in solving their problems. Rather, they tended to jump in wade around in the database, searching through various categories, to see what seemed to fit. As noted before, an important inhibitor might be the lack of "mental process models" held by students. The presence or absence of such models appears particularly critical at this point in the problem solving units. It was also in this stage of the process that students' ignoring the meanings of database categories became an inhibitor.

An exception from the field notes of one teacher should be noted, as it represents a model of what a successful group did in the first parts of this problem solving phase:

> ...one successful group spent a lot of time reading the category definitions, and looking at individual years with all variables. Then they searched for patterns by ZOOMing from a single year's record to multiple variable screens for successive yeals. They were satisfied with this strategy and made a lot of progress.

There were unexpected strategies invented by students. These make sense when hindsight is used, but were not anticipated by the teachers or researchers. For example, one teacher was surprised that students wanted to print all of their data off at the same time--he imag d that they would go back and forth, printing new relevant information after they had analyzed smaller amounts retrieved at fi .r. The students, in contrast, seemed to be aiming for efficiency--they wanted to get on with their probl n work, and not be bogged down with unnecessary repetition with the computers.

Another example is best explained by reproducing some field notes:

> Teams which made progress did <u>not</u> use the database as planned (use the READ selection option to "make connectio..s"). Instead, most groups used ARRANGE to sort columns of data from high to low (or vice versa) and then use the down arrow to scan down columns to look for relationships.

Some students--reported in the field notes from the Indiana and Washington classrooms--encountered difficulty with "information overload". It was noted that the younger 5th and 6th grade students in Washington were overwhelmed by the sheer magnitude of data in the GeoGraph databases, and as a result unit objectives had to be sca ed back considerably. It was noted that in Indiana teacher #2's class that

> ...students avoided overload when the teacher insisted upon students making judgments about what data were most relevant, and throwing out marginal or irrelevant categories, so that attention could be addressed to what was most important.

This leads to another important issue--how the students figured out when they had enough information to address their problems. While there was not much overt evidence in the classroom observations, or in student debriefings, that students used deliberate strategies to determine information sufficiency, students nevertheless seemed to understand that it is important. Most of Indiana teacher #2's students responded during unit debriefing that they used their hypothesis as the primary criterion

to determine if they had enough information. Students in Minnesota #2's classes mentioned group discussion, following teacher directions, and trial and error as their means for judging sufficiency.

Importantly, students in several of the classes complained that the databases did not contain enough information to address their problems fully, and they had to search out other sources of information, typically in the library. This was a significant indicator that students were sensitive to the information sufficiency issue, and that they (correctly) concluded that they needed more information than they would usually get from one source. They were not blindly following a recipe in their work, but were thinking about the problem and how to attack it. Of course, we observed exceptions to this generalization. Other reasons might explain this apparent positive attitude. Nevertheless, students' wanting more information, and needing to use multiple sources, were very positive evidence of students' higher order thinking processes in the classrooms we studied.

Some students also commented on whether they preferred to obtain data via computer databases or in reference books. There was a spread of opinion about this, but most concluded that the two forms were equally good, and should be used to complement each other, and neither should be excluded, because depending on only one could be misleading. Some students gave explanations or examples which showed they understood how that might happen. However, they tended to like the computer databases because "all of the information is in one place" compared to books, they were convenient and easy to access, and students could print data off automatically rather than having to copy by hand.

There were assorted practical difficulties encountered as students used the databases to go back and forth with data and their questions. The GeoGraph programs have a long bootup time on the Apple IIGS computers, and the print times of some of their outputs were also very long. Mechanical problems were most often experienced with printers, which jammed, became unplugged, and caused bottlenecks because they were often shared between two or more computers. In only one case did insufficient numbers of computers cause any problems; in another classroom there were insuffient program diskettes.

Non-mechanical problems arose as a result of AppleWorks limitations. Six of the eight teachers used plain AppleWorks with a homemade database, or a commercial database using AppleWorks, on Apple IIe's. (The other two teachers used the MECC USA and World GeoGraph programs on the Apple IIGS). AppleWorks on the IIe displays only a few categories of data on one screen, and arranging selected categories side by side on the screen, while possible, is somewhat complicated and surely cumbersome. The database is limited to 30 categories.

Students learned to use these databases, but went through cycles of forgetting and relearning of many of the commands. As mentioned in an earlier section, this was most often a problem in classrooms in which insufficient instruction and practice was provided before beginning this problem solving stage. In contrast, the 5th and 6th graders in Washington caught on to USA and World GeoGraph quickly, and it did not seem to interfere with the inquiry processes as was true with AppleWorks in the other sites. We concluded that AppleWorks is an inhibitor, in that it focuses the user's attention on the database utility itself, whereas the GeoGraph programs tend more to facilitate thinking processes of the user by focusing on the application of knowledge.

N. Students report on the results of their problem solving; teacher evaluates the reports on the following criteria:
  - clarity of problem description
  - workability fo hypothesis or question
  - quality of data used:
    - relevance
    - sufficiency
    - fairness of use
    - quality of organization and display
  - reasonableness of conclusion

O. Teacher leads a debriefing of the activity

Student groups made oral reports in nearly all classrooms in the study. Written reports were required of five of the eight teachers. We did not see evidence of any teacher systematically using the criteria listed above to give oral or written feedback to students. The reports themselves varied widely in format and quality. Some teachers were convinced that the reports demonstrated that students had used a problem solving approach and were able to organize and synthesize information in addressing these problems. Others were distressed at what they saw as superficial and unconnected use of information,

where it seemed that students were just following a formula. The researchers' analysis of the reports resulted in the same range of positive and negative judgments.

A positive picture is reflected in the reports of Indiana Teacher #2. It was noted that in six of the seven groups, the hypotheses being addressed were rejected fully or partially because the data did not support them. The students usually tried to explain discrepancies, and sometimes modified the hypotheses as a result. It was clear that the hypotheses were not "cooked up" by the students to conform to data they already had, but were actually being used to guide their inquiry. The students in this classroom were also very sensitive to the information sufficiency issue discussed above.

We believe that whatever the quality or form of the reports, they are an important part of the problem solving process, in that they provide a need for and means of organizing the thinking required. Without the reports, it is doubtful that students would have been as on task as they were in these classrooms. The "publication" and presentation of the inquiry results were also important parts of the public aspect of problem solving. In some cases fruitful student-student and teacher-student interaction was promoted.

Teacher led debriefings that were conducted at the end of the units (not all teachers included this part) were not fruitful. They were anticlimatic, and it was clear that neither the teachers nor the students had their hearts in the unit end debriefings.

General Observations about the Problem Solving Process.

Teachers made a number of general comments about the process as a whole. They agreed that the problem solving process is difficult to orchestrate for them as teachers, but that many of the students understood it and were able to synthesize and apply information to problems they chose. Not surprisingly, the 5th and 6th grade teachers in Washington thought the process most unfamiliar for their students; nevertheless, the researchers observed these students developing grounded descriptive generalizations about their states and countries, comparing them, and testing information against the makeup of their "perfect countries".

Students reported feeling more confident in their use of data, more intelligent about and critical of statistics. They generally enjoyed using the computers to access a lot of information quickly and easily. Some were positive about the break from routine classes, where they had more freedom to chose problems and ask questions they were interested in, and work at their own pace.

The researchers observed over and over in the field notes and in post observation discussions that lack of structure and organization by the teachers was a major problem. Where teachers were most successful, they acted as "metacognitive guides" who provided students a clear roadmap of the unit at the beginning, and then gave continuous reinforcement and guidance to show individuals, groups, and their whole classes where they had been, where they were at the time, and where they were going. This required these teachers to be fast on their feet, especially when students were working in groups. But this "metacognitive guidance" was essential for the students. In cases where it was completely lacking, the quality of student work suffered, and students became impatient and discouraged.

One mechanism for giving this guidance is through regular, short debriefings in the whole class setting. These focus on specific phases of the groups' progress, and include examples from groups of successes and difficulties, and examples from the teacher, if needed, of ways to carry out various parts of the process. These debriefings are also an opportunity to reinforce and clarify expectations for the students. We believe that using these debriefings regularly is far more important than unit end debriefings, which in our case studies were not useful.

The need for clear structure and expectations, metacognitive guidance, and regular debriefings through the problem solving process are among the conclusions and recommendations of this research.

VI. Conclusions and Implications for Successful Practice

When we stood back from close inspection of the many details in our the separate cases, and reflect on the broader scene, we saw some overarching themes worth summarizing. The great importance of careful structuring and metacognitive guidance are paramount, and we discuss those shortly. First, however, we will return to the "overlay factors" presented before.

Time. Time pressure impacted on teachers and students alike. Closely related to time pressure was the extent of integration of the computer based problem solving into the teacher's social studies curriculum. Where the integration was high, the time pressure seemed not much of a problem. But where the problem solving was "tacked on" to the regular curriculum, the prevailing approach seemed to be one of hurrying on to the next task, and then to the end of the unit, rather than focusing on problem solving outcomes.

There are specific ways teachers and students can make good use of time--by doing simple things like using the regular classroom as much as possible, and when using a computer laboratory or library for information gathering, by meeting there and spending the whole period there rather than moving back and forth. Good introductions to, practice of, and teacher guidance through various aspects of computer use, and of the problem solving components, also save time in the long run by avoiding unneeded repetition of instruction and students' directionless work. As important as practice is providing students with "mental models" of problem solving processes.

Students' Knowledge. Lack of student knowledge must be anticipated by the teacher, who has to incorporate specific ways of overcoming the problem in teaching. For example, student knowledge of meanings of database categories is essential if they are to use information in the databases in problem solving. The teacher should devise ways of having students learn these meanings and then check their knowledge. The same is true of students' content knowledge about the general problem area in the teaching unit. Having students swim in a lake of data in the pitch dark can do little for their thinking skills!

Cooperative Student Groups. Using small, non-competitive groups of students works well. If there are interesting problems, and strong guidance by the teacher, students cooperate within and across groups, teach each other, and learn important skills. They like the group work, and challenge one another to think. Problem solving with computer databases is an excellent teaching situation in which to use small groups in social studies.

Structure in Problem Solving. Teaching problem solving processes is difficult in any case, and employing computer databases as part of the processes complicates it for teachers and students. One clear conclusion we have made after observing, interviewing, and thinking about our case studies, is that while the computer aspect of the teaching and learning was significant and useful in an overall sense, it was the problem solving processes, and their potential outcomes, that were by far the more important phenomena to research. Furthermore, the degree of structure. teachers' use of examples and modeling of processes, and metacognitive guidance, were the most important factors leading to effective teaching of problem solving.

It might appear contradictory to emphasize structure so much when discussing problem solving in social studies. Some might argue that because true student problem solving must be openended and fluid in nature, teacher imposed structure would inhibit positive outcomes. We believe differently. Because of the openendedness and fluidity of problem solving, structure provided by the teacher adds a needed source of support for students who might otherwise not succeed because of uncertainty of what to do, and lack of practice and skills required. Keeping track of the "big picture" of problem solving, especially when it involves computer databases, is often difficult, and clear structure assists students to find that picture and keep it in focus.

The extent to which the teachers used clear structure in their unit planning and teaching was the most critical factor separating positive from negative cases. By structure we mean a combination of several interlocking components They include the unit introduction, incorporating clear expectations and a sequence of activities, the development and modeling by the teacher, and practice by the students, of key problem solving elements; and the provision for regular checking of students' progress in accomplishing the "milestone" tasks that make up problem solving.

Introductions are critical. They are the point at which the teacher familiarizes students with the "big picture" of the unit. The most successful teachers drew their students into the problem area without undue emphasis on the computer aspects of the units. They also set forth clear expectations for student work and outcomes, including intermediate "milestones" in the process. Introductions were a good time

for the teacher to use an simple example of a "problem" and work on it through parts of the problem solving process, so that the "big picture" was reinforced.

Teachers' use of examples, modeling of various problem solving steps and processes, and providing for student practice, were very important to the success of units like the ones we studied. Without the examples, modeling, and practice, students tended to drift and wander, rather than carry on with purposeful activity.

Teachers' also reinforced structure through the use of regular, individual checking of students' work at key points, as well as through whole class debriefings of particular phases of the process. One of our teachers pointed out that it is wise to have a brief five-minute period each day in which the teacher leads the class in summing up where they have been, what they accomplished that day (or the previous day,) and where they are about to go. Based on this research, we believe that this kind of regular debriefing was far more important in its contribution to the units' success than the unit-end debriefings.

Associated with the practice of regular debriefings is that of asking students for interim written products of their work, checking these products, and giving clear feedback and suggestions to students to assist them in the process. The students of teachers that did this were much more successful than those whose teachers didn't.

These are examples of what we mean by "metacognitive guidance" by the teacher. The importance of that guidance in helping students keep the "big picture" in focus cannot be emphasized too much.

It is important to include some public sharing by students of the results of their problem solving at the end of the unit. It gives students, and teachers, a solid target to shoot for. It also emphasizes one key value of inquiry--its public nature, the idea that results should be scrutinized by others.

Another pair of conclusions with clear implications for practice have to do with computer databases themselves. First, databases like AppleWorks are of limited utility. They lack a graphics-oriented user interface, and are limited in their capacity to store, manipulate, and display information.

Further, they overemphasize numerical data in a field, social studies, which should balance numerical data with text, pictoral, and graphically-depicted information. Second, even teachers with considerable computer experience cannot be expected to do the planning, design, research, data entry, and detailed checking necessary to produce useable databases in their classrooms. Well developed commercial products will, in most cases, be much more dependable and useful problem solving tools than teacher made databases.

In conclusion, the case studies in this research revealed much that was good--good teaching practices, as well as positive student outcomes, such as developing skills necessary for problem solving and valuing multiple sources of data. Of course, there was also much that was negative. But even that was often instructive. We believe that there is much potential for problem solving with computer databases in social studies. Of course, there is much yet to be learned, and we now turn to a brief consideration of that topic.

VII. Implications for Research

There are a host of possible research projects which might be suggested on the basis of this study, both in the qualitative and quantitative realms. But we are pessimistic about the worth of conducting extensive inquiry based on the typical computer "environment" now encountered in social classrooms. The use of AppleWorks on Apple IIe computers tends to make the computer user the servant of the database, rather than the other way around. The teacher is equally subservient to the computer/software system, given its limitations on numbers of variables, cases, and retrieval/display functions.

We did see the glimmer of a potentially useful environment with the USA and World GeoGraph programs running on the Apple IIGS computers in Washington. The user interface is mouse-driven and graphics oriented, rather than being oriented strictly to words on the screen and commands like "OPEN APPLE/C", as with AppleWorks. The GeoGraph programs employ graphics like maps, charts, and graphs, and permit printing of these graphics, along with raw data. It is with this type of database that we

believe research might be productive. Otherwise, we might be wasting our time researching ineffective tools that belong in the museum, where they should be examined with curiousity, reverance, and awe, but not subjected to tests of their low utility.

One topic that should be researched is the effectiveness of the visual components of databases. Another is whether manipulation of data within the database by students is an important part of information skill outcomes. Still another set of questions about non-numerical databases should be studied. The use of text, as in the Cornelius (1986) study, where information from legal cases was presented as data, is one alternative. Another is the use of images--still and moving pictures--now being made possible by such image-based packages as National Geographic's GTV and others. Using hypermedia-based databases will certainly become more common in social studies classrooms, and numerical data in databases will be relegated to a supplemental place.

Ecological problems also should be researched with modern database/computer environments. One is whether problem solving units using computers can be taught effectively in the social studies classroom with just a few computers, perhaps on loan for short periods, rather than depending upon the now-common centralized computer laboratories. This is an important question, because it might impinge on the degree of true integration of computer resources into the social studies curriculum. Sheingold, Kane, & Endreweit (1983) asserted that centralizing computers outside the regular classrooms helps avoid integrating them with the regular classroom (p. 428). If they are correct, then studies like the present one, situated within the regular classroom, could be important keys for how to solve computer/curriculum integration problems in social studies.

Practical issues such as teacher training and extent of required support of teachers in small group teaching settings should also be addressed. They are part of a larger set of cost-effectiveness questions having to do with how much extra time, effort, and funds are required to gain how much extra benefit in terms of student learning, or in terms of teacher time demands.

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Table 1

Characteristics of the Field Experiments Reviewed

Study

	Cornelius (1986)	Elder (1988)	Rawistch (1987,88)	Rawistch et al (1988)	Underwood (1985)	White (1986,87)
Grade Level	12	9	8	7	NA	7-12
Student Ability Level	College Prep	Low and Average	NA	NA	NA	NA
Total Student N	36	214	339	158	NA	315
Small Groups Used?	No	Yes	NA	NA	NA	Yes
Subject	World Cultures	Geography	NA	U. S. History	NA	Varied
Unit Topic	26th Amendment (18 yr old vot[illegible]	World Geography	World Nations	1) West Expansion 2) Civil War	NA	U.S. History & U.S. Government
Database Used	Text about legal cases	Researcher-made	Researcher-made	1) Oregon Trail 2) Rchr-made C.W.	Factfile; Seek	Scholastic PFS U.S. Hist/Govt
Treatment Length in Days	2	15	8	1) Comp simul: 3 2) Comp db: 6	15	10
Nature of Treatment Groups	1) Linear srch 2) Keyword srch 3) No computer	1) 2 comp in room 2) 15 comp in lab 3) No computer	1) Computer 2) No computer	1) Comp simul 2) Comp db	1) Computer 2) No computer	1) Computer 2) Nocomputer
Random Assignment?	Yes	No	NA	Yes	NA	Yes
Outcome Meas Reliability	Ach test: .74 Att test: .91	Inf proc scl: .57 Geog test: .62	1) # prob slv: NA 2) Time taken: NA 3) Efficiency: NA	1) Propr Reas: NA 2) Deduc Reas: NA	1) Classif: NA 2) Facts: NA	1) IPS: .66 IPS= Info Process Scl
Outcome Meas Effect Size	Ach test: + .61 Att test: +1.08	Inf proc scl: +.10 Geog test: NA	1) # prob slv: +.35 2) Time taken: -.33 3) Efficiency: -.03	1) Propr Reas: NA 2) Deduc Reas: NA	1) Classif: NA 2) Facts: NA	1) IPS:+.27
Significant Differences?	Ach test: No Att test: Yes, linear srch best	Inf proc scale: No Geog test: No	1) # prob slv: Yes 2) Time taken: Yes 3) Efficiency: No	1) Propr Reas: No 2) Deduc Reas: No	1) Classif: Yes 2) Facts: No	1) IPS: Yes

Table 2

Characteristics of the Impressionistic Field Studies Reviewed

	Study				
	Ennals (1985)	Hawkins & Sheingold (1986)	Medrinos & Morrison (1986)	Rothman (1982)	Traberman (1983,84)
Grade Level	Secondary British	6	6-8	11-12	10-12
Student Ability Level	NA	NA	NA	NA	NA
Total Student N	NA	1 class	NA	NA	NA
Small Groups Used?	NA	NA	Yes	NA	Yes
Subject	Local Studies	NA	NA	NA	Global Studies
Unit Topic	Village history	NA	Irish Immigration	Revolutions	Third World Geog/Econ Concepts
Database Used	Rschr-made on village	Used for recording information	Irish Immigrant	Rschr-made; graph output	Rschr-made in APL
Treatment Length in Days	NA	40	NA	NA	NA

Table 3

Characteristics of the Eight Teachers' Classrooms

	Teacher							
	IN #1	IN #2	MN #1 (5 classes)	MN #2 (4 classes)	VA #1 (2 classes)	VA #2 (2 classes)	WA #1	WA #2
Gender	Male	Male	Male	Male	Female	Female	Male	Male
Years Experience	6	7	25	19	14	14	10+	10+
Experience W/Computer Databases	High	Low	High	Low	Moderate	Low	High	High
School Size/Type	Small Rural	Small Rural	Large Surburban	Large Suburban	Medium Surburban	Medium Suburban	Large Surburban	Large Surburban
Grade Level	12	10/11	9	12	12	9/10	5	6
Subject	Economics	U.S. History	American Civics	Social Problems	U.S. Government	World Studies	Social Studies	Social Studies
Student Ability Level	Average	Above Average	Average	High	Below Average	Below Average/Average	Average	Above Average
Student N	24	16	29-34	31-33	17/21	16/25	28	30
Unit Topic	Classifying Developed/ Developing Nations	Census and Local Social History	Foreign/ Domestic Social/Econ. Problems	Problems of/ Solutions to Minnesota Econ. Probl.	Legislative/ Executive Branches over Time	Current World Problems	Fifty States	Geography of U.S. and Europe
Unit Length in Days	14	11	11	19	10	10	10	2 units Spanned 45 days
Database Used	MECC World Communities	Researcher-created AW Local Census	Researcher-created AW World Nations	Researcher-created AW Minnesota data	Newsworks Amer. Govt.	Newsworks World Community	MECC USA GeoGraph	MECC USA and World Geograph
Computers/ Printers	20 App IIe 10 Printers	15 App IIe 6 Printers	24 App IIe 6 Printers	14 App IIe 7 Printers	9 App IIe 2 Printers	9 App IIe 2 Printers	15 App IIGS 15 Printers	12 App IIGS 4 Printers
Student Group Size	2	2-3	2-3	2-4	3	3	2-3	4

Table 4

Research Method Features

	Teacher							
	IN #1	IN #2	MN #1	MN #2	VA #1	VA #2	WA #1	WA #2
Dates of Case Study	3/22-4/20	4/11-4-23	4/16-4/27	4/26-5/24	4/21-6/4	4/21-6/4		
Student Interview/ Debriefing (Post-unit)	Whole Class	Whole Class	Interview of 6 teams	Interview of 2 teams	None	None	None	None
Student Quest?	None	None	Pre-unit	Mid-unit	None	None	Post-unit	Post-unit
Video Taping?	None	None	Small group activities	Whole class activities	Oral Reports	Oral Reports	None	None
Extent of Researcher Unit Prep.	None	Moderate	None	None	Moderate	Minimum	None	None
Extent of Teacher Training by Researchers	None	1 hour	None	2 hours	12 hours	12 hours	1 hour	1 hour
Same Teacher as in Fall Pilot Study?	Yes	Yes	Yes	Yes	Yes	Yes	No	No

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